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ISRO GOES FROM STRENGTH TO STRENGTH

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Introduction

India's space program commenced in 1962 with the formation of the country's first organisation for space technology development and exploitation for the greater good – Indian National Committee for Space Research (INCOSPAR)[1]. INCOSPAR was superseded with formation of the Indian Space Research Organisation (ISRO) in 1969[2]. ISRO initially started its journey in the field of satellite development. Over time, ISRO expanded its efforts into other areas as well. Rocket development is one such field as is the delivery of usable technology for use by the country at large for economic and livelihood projects. ISRO's achievements have been written about in various journals, print and electronic media as well as on this website regularly over the past several years. ISRO has demonstrated great focus in the field of technology development and achievement of stated aims. ISRO, despite its noteworthy achievements, has some way to go to catch up with the world leaders in space technology.

Landmarks Achieved by ISRO

Starting with the design and manufacture of relatively basic satellites in the 1970s, ISRO has demonstrated its ability to manufacture even advanced communications, meteorology, remote sensing, navigation and earth observation satellites through deployment of its in house expertise. Starting with the initial satellite launch vehicle (SLV)-3 ISRO has demonstrated its ability to build more capable launch vehicles.[3] ISRO's polar satellite launch vehicle (PSLV) is its workhorse launch vehicle that has a record of over 35 successful high precision launches, at one of the lowest launch costs per kilogram (kg) to back its claim to excellence.[4] More recently, ISRO has proven its indigenously designed and built cryogenic upper stage (CUS) engine in launches of its geosynchronous satellite launch vehicle (GSLV) in its GSLV and GSLV Mk-II variants. The last GSLV Mk-II launch in August 2016 carried a 2111 kg satellite to geosynchronous transfer orbit (GTO), the heaviest satellite launched from Indian soil till date. With this proving launch of GSLV Mk-II,

ISRO has demonstrated its ability to lift up to 4000-5000 kg payloads to low earth orbit (LEO).[5] In an endeavour to reduce launch costs even more, ISRO has initiated a test program to develop a reusable launch vehicle (RLV).[6] The initial trials of this project in May 2016 and August 2016 have been fully successful and have involved the testing of thermal insulation for atmospheric re-entry of a spacecraft, autonomous navigation by the spacecraft to a pre-designated point on the earth's surface, design and flight testing for a hypersonic glide vehicle, autonomous landing manoeuvre by the hypersonic glide vehicle after its atmospheric-entry and hypersonic flight phase and deceleration, and the flight test of supersonic combustion ramjet (Scramjet) engines.[7] These tests indicate a measured and carefully thought out development phase for a futuristic launch technology aimed at making space access more affordable.

ISRO has a successful moon mission Chandrayaan-1[8] and the Mars orbiter mission (MOM)[9] also under its belt. While Chandrayaan-1 gave the benefit of an Indian footprint on the moon and provided useful information for further exploitation, it was conducted at the lowest cost ever for a moon mission.[10] MOM likewise showcased ISRO's immense capabilities, especially as it was the first time that a country's Mars mission succeeded on its first attempt. Even the US and erstwhile USSR had several failures in their missions to Mars, while China has yet to reach the red planet successfully. To cap this achievement, MOM was executed once again at the lowest cost ever for such a mission.

ISRO appears well satisfied with its achievement to date. However, there are strong indications that ISRO does not intend to rest on its laurels. The known development and future technology development and mission plans available in the public domain give rise to the expectation that more great news will be forthcoming from ISRO in the months and years ahead.

Known Future Plans of ISRO

In the field of launch technology, ISRO is developing a more powerful variant of its CUS and hopes to test the GSLV MK-III before the end of 2016.[11] The new GSLV once proven will enable even heavier satellites than are possible today to be carried to LEO and GTO. This step will help free the country of booking launch slots on foreign launchers even for its heaviest satellites.

The RLV project is continuing in parallel. Once the individual technologies earmarked for RLV are tested and developed further, in the medium term the test program for the definitive RLV could commence. If this program proceeds as planned then in the coming two decades or so ISRO could reduce its already low per kg launch costs by an order of a magnitude to retain its position as the world's most reliable, precise and

lowest cost launcher of payloads to outer space. Implications of this ability are that the country will be able to field space technology for the betterment of the country's population at affordable costs, making such space exploitation efforts more cost effective.

Several component parts used in ISRO satellites and rockets are at present imported for reasons of economies of scale and technology availability in the country. ISRO is attempting to reduce import dependence by developing indigenous equivalents of these imported parts so that its programs are insulated from foreign technology denial regimes etc. in future. Two such components being indigenised by ISRO are transponders used on satellites, and atomic clocks. While the former are utilised in all communications satellites as well as on a few special mission satellites, the latter find application on navigation satellites such as the Indian Regional Navigation Satellite System (IRNSS) satellites.[12] Atomic clocks enable the precise determination of distance and orientation required for accurate position determination using a satellite navigation system. Once these components are indigenised by ISRO, the country will be more independent of external pressures from foreign powers.

As far as ISRO's space missions are concerned, it already fields the world's largest constellation of civil earth observation satellites optimised to assist in human welfare through agricultural monitoring, forestation monitoring, water body observation and mapping and natural resource mapping and exploitation activities. ISRO also has a large number of transponders deployed for national use and has put up an American Global Positioning System (GPS) based wide area differential GPS system for commercial use and an independent regional navigation satellite system. Full exploitation of the IRNSS system remains a work in progress as receivers optimised for IRNSS are yet to find full market penetration. ISRO has plans for its next moon mission Chadrayaan-II, which could involve a soft landing of a moon rover craft for exploration on the moon's surface. Mars could also be revisited in the near future. Venus is also being examined as a possible target for ISRO's inter-planetary exploration efforts.[13]

All indications are that ISRO will continue its dedicated and focussed efforts to achieve success in its technology development effort and improve the country's space capabilities over time.

Implications for National Security

While ISRO remains a civil organisation with a charter to develop space technology for civil human development purposes, technology is technology. Once developed, technology can be used for several different purposes.

In the civil, arena, ISRO's efforts should help the Indian economy become more efficient,

leading to robust economic growth. A higher rate of economic growth could help raise millions out of poverty. A higher income population alongside a richer government and common man would help increase the country's standing in the comity of nations while allowing for a more effective security system both at the national and individual levels. This economic growth would also translate into more potent armed forces, both military and police, equipped with more effective tools to carry out their duties.

Obvious spin offs from ISRO R&D are faster cheaper access to space at short notice, more capable satellites deployable to LEO and other orbits for national security purposes, space defence and space offensive capabilities available to be deployed and exploited if needed etc.

Conclusion

ISRO, since its formation in 1969 has carried out a gradual process of capability enhancement in space activities. The dedicated efforts have led to several world beating capabilities being developed and deployed. The future known plans of ISRO indicate a further strengthening of India's space capabilities to bring them at par with those of more advanced space faring nations, and in some cases even ahead of them. The capability development by ISRO has obvious benefits for the country's economy and economic activity. In addition these indigenous capabilities have spinoffs of benefit for the security of the country as well.

Overall ISRO is adding to India's self-sufficiency and ability to grow faster as well as its ability to keep itself secure from outside as well as internal threats and challenges.

(Disclaimer: The views and opinions expressed in this article are those of the author and do not necessarily reflect the position of the Centre for Air Power Studies [CAPS])

Notes

[1] http://www.isro.gov.in/about-isro, accessed on October 24, 2016.

[2] Ibid.

[3] Brugge, "Space Launch Vehicles", http://b14643.de/Spacerockets_1/India/India.htm, accessed on October 25, 2016.

[4] Isro.gov.in, "Indian Space Research Organisation", www.http://isro.gov.in/, accessed on October 25, 2016.

[5] Isro.gov.in, "Geosynchronous Satellite Launch Vehicle (GSLV)", http://isro.gov.in/launchers/gslv, accessed on October 25, 2016.

[6] Isro.gov.in, "RLV-TD", http://isro.gov.in/launcher/rlv-td, accessed on October 25, 2016.

[7] Ibid.

[8] Britannica.com, "Chndrayaan-1", https://www.britannica.com/topic/Chandrayaan-1, accessed on October 25, 2016.

[9] Masdison Park, "India's spacecraft reaches Mars orbit ... and history", http://edition.cnn.com/2014/09/23/world/asia/mars-india-orbiter/index.html, accessed on October 25, 2016.

[10] Scott Neuman, "Why India's Mars Mission Is So Much Cheaper Than NASA's", http://www.npr.org/sections/thetwo-way/2013/11/04/243082266/why-indias-mars-mission-is-so-much-cheaper-than-nasas, accessed on October 25, 2016.

[11] Tomasz Nowakowski, "ISRO Successfully Tests Its GSLV Mk III Cryogenic Engine", http://www.science20.com/astro_watch/blog/isro_successfully_tests_its_gslv_mk_iii_cryogenic_engine-154041, accessed on October 25, 2016.

[12] Debu C, "Secret behind ISRO's next Interplanetary Mission", http://www.mapsofindia.com/my-india/india/what-is-the-secret-behind-isros-next-interplanetary-mission, accessed on October 25, 2016.

[13] Ibid.